

# ***AASHTO MATERIALS REFERENCE LABORATORY***

***REPORT FOR***

***THE SECOND ROUND OF  
THE "TAPE TEST" FOR SURFACE MOISTURE OF FINE  
AGGREGATE  
PERFORMED ON  
FINE AGGREGATE PROFICIENCY SAMPLES 131 & 132***

***JULY 2001***

## **INTRODUCTION**

The accompanying explanations, tables, scatter diagrams, and charts constitute the final report and summary of results for testing Aggregate Proficiency Sample No. 131 and No. 132 using the proposed "tape test" method for determining the surface moisture of fine aggregate. Only sponsor laboratories were invited to participate in the program. The samples were sent to participants on March 8, 2001. The samples included instructions and a data sheet for reporting results. A block of wood and a length of water activated tape were provided, although laboratories were permitted to use their own woodblock and tape if they desired.

Data from 42 laboratories are included.

The material included in this report consists of the following:

- (1) Description of the Study and Modifications to T84-00,
- (2) Summary of Results Tables,
- (3) Four Scatter Diagrams,
- (4) Responses and Comments from Participating Laboratories,
- (5) Graphical Comparison of "Tape Test" vs. "Cone Test", and
- (6) Tables of Test Results provided by Participating Laboratories.

All data were processed as received. Results differing from the average by more than three standard deviations were removed. The summary of results tables show the averages, standard deviations and coefficients of variation obtained before and after removals. The scatter diagrams show the results remaining after all removals indicated on the summary of results table.

## **Description of the “Tape Test” Study Provided to Participating Laboratories with Instructions and Modifications to T84-00**

The information below and on the following page was provided to laboratories participating in the second round of the study. The description gives a brief explanation of the purpose of the study and presents modifications to AASHTO Test Method T84-00 that were to be followed when performing the “tape test” for the purposes of this study. The modifications to T84-00 used for this study were adapted from a proposal provided by the Texas Department of Transportation based on Test Method Tex-201-F.

### **Second Round of the Study of the “Tape Test” for Surface Moisture of Fine Aggregate**

There has been considerable discussion on how to determine the saturated surface-dry condition of fine aggregate materials that do not readily slump when the “cone test” is performed in accordance with AASHTO Test Method T84 (Specific Gravity and Absorption of Fine Aggregate). One alternative method that has been proposed is the “tape test”. Technical Section 1c, of the AASHTO Subcommittee on Materials, wants to collect more data to compare the results obtained using the standard “cone test” in T84 to results obtained using the proposed “tape test”. Sponsoring laboratories are again requested (1) to perform the “tape test”, described in the modified procedure for AASHTO T84 shown at the bottom of this page, on AMRL Fine Aggregate Proficiency Samples 131 and 132, (2) to test the samples using the standard “cone test” procedure, and (3) to report both sets of results to AMRL. Please report the results using the “tape test” in the table on the back of this page. **Report the results using the standard “cone test” (T84, C128) in the usual manner on the data sheet provided by AMRL for Fine Aggregate Proficiency Samples 131 and 132.**

[THE INSTRUCTIONS BELOW ARE TO BE USED SOLELY FOR THE PURPOSES OF THIS SECOND ROUND OF THE STUDY. THESE INSTRUCTIONS HAVE BEEN CHANGED SLIGHTLY TO ADDRESS COMMENTS FROM THE FIRST ROUND. HOPEFULLY, THE CHANGES WILL CLARIFY THE PROCEDURE AND IMPROVE THE TEST PRECISION.]

**SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE  
USING THE “TAPE TEST”  
(MODIFICATIONS TO AASHTO DESIGNATION: T 84-00)**

**4. APPARATUS**

- 4.5** *Woodblock and Paper Tape Having Water-Activated Adhesive* – The paper tape shall have water activated adhesive and shall be heavy gummed on one side and approximately 51mm (2 in.) wide. Attach a strip of the water-activated paper tape, with the gummed adhesive side facing outward, to a small block of wood. The length of the strip of tape, the size of the woodblock, and the method of holding the tape in place on the woodblock shall ensure that approximately 10 cm<sup>2</sup> (4 in.<sup>2</sup>) of the adhesive side of the tape is exposed on one face of the woodblock. Keep the paper tape and wood tape blocks in a dessicator at all times and only take them out when ready to check the SSD condition of the fine aggregate. A new piece of tape must be used for each sample to be tested.

**6. PREPARATION OF TEST SPECIMEN**

- 6.2** Replace the 5th sentence with the following:

Follow the procedure in Section 6.2.2 to determine whether or not surface moisture is present on the constituted fine aggregate particles.

**6.2.2 Tape Test for Surface Moisture**

The fine aggregate sample shall be air dried in a large, smooth, clean, nonabsorbent pan. It is important that the surface of the pan be free from all chemical residue, including residue from materials used to clean the pan. Tilt the pan at approximately a 45 degree angle to cause the fine aggregate to flow to one end of the pan. With the pan tilted, thoroughly stir the sample with a dry, flat trowel. Level the sample with the trowel, then dig down into the fine aggregate to expose the middle half of the sample. Level the sample with the flat side of the trowel until the trowel ceases to rock back and forth. Immediately remove the tape block from the dessicator. (Check the gummed paper tape just prior to use. If the adhesive side feels sticky because of humidity, rub it rapidly against a dry cloth just prior to placing it on the test sample.) Without exerting any pressure on the test sample, place the adhesive side of the tape block on the exposed surface of the sample. Leave for 5 seconds. Gently lift the woodblock and tape upward, taking care not to slide the tape along the top of the test sample. Observe the number of test sample particles that are adhering to the water-soluble glue of the paper tape. When the test sample is dry enough so that no more than one particle adheres to the gummed paper tape on two consecutive checks, the sample is judged to be surface-dry.

## Summary of Results Tables

The Summary of Results tables provide a summary of the statistics for each test property analyzed both before and after the removal of data beyond three standard deviations. The tables give the following information:

- a) Column 1 - Abbreviated titles for each test property analyzed,
- b) Column 2 - The number of laboratories included in each analysis,
- c) Columns 3 & 6 - The average values for both samples of the pair, and
- d) Columns 4, 5, 7 & 8 - The between-laboratory standard deviations and coefficients of variation.

Results were analyzed with all apparently valid data included, and then reanalyzed to exclude data in excess of 3.0 standard deviations of the mean. If only one of the paired test results for a given test was excluded based on this 3.0 standard deviation criteria, then the other test result was automatically excluded from the analysis.

### SUMMARY OF RESULTS FOR "TAPE TEST"

FINE AGGREGATE PROFICIENCY SAMPLE		SAMPLE NUMBER 131			SAMPLE NUMBER 132		
TEST RESULT	NO. OF LABS	AVG.	STAND. DEV.	COEFF. VAR.	AVG.	STAND. DEV.	COEFF. VAR.
Bulk Specific Gravity	42	2.6203	0.021	0.785	2.6261	0.047	1.800
	40	2.6227	0.016	0.600	2.6218	0.013	0.488
Bulk Specific Gravity (SSD)	42	2.6316	0.015	0.571	2.6331	0.014	0.537
	40	2.6340	0.010	0.389	2.6348	0.011	0.409
Apparent Specific Gravity	42	2.6532	0.016	0.613	2.6591	0.016	0.620
	40	2.6524	0.013	0.475	2.6563	0.011	0.399
Absorption (%)	42	0.480	0.28	59.1	0.568	0.33	57.8
	40	0.442	0.17	39.1	0.506	0.17	34.4

*Note: The shaded rows show results before outlying data was removed.*

### SUMMARY OF RESULTS FOR "CONE TEST"

FINE AGGREGATE PROFICIENCY SAMPLE		SAMPLE NUMBER 131			SAMPLE NUMBER 132		
TEST RESULT	NO. OF LABS	AVG.	STAND. DEV.	COEFF. VAR.	AVG.	STAND. DEV.	COEFF. VAR.
Bulk Specific Gravity	42	2.6143	0.014	0.521	2.6146	0.012	0.455
	42	2.6143	0.014	0.521	2.6146	0.012	0.455
Bulk Specific Gravity (SSD)	42	2.6291	0.012	0.447	2.6292	0.011	0.402
	42	2.6291	0.012	0.447	2.6292	0.011	0.402
Apparent Specific Gravity	42	2.6571	0.015	0.560	2.6574	0.013	0.502
	41	2.6555	0.011	0.417	2.6559	0.009	0.347
Absorption (%)	42	0.599	0.19	32.5	0.593	0.15	25.7
	41	0.582	0.16	27.8	0.593	0.15	26.0

*Note: The shaded rows show results before outlying data was removed.*

### Scatter Diagrams

The points on each of the following scatter diagrams are located by plotting the test value reported for the odd numbered sample of a pair from a given laboratory on the horizontal axis, against the test value reported for the even numbered sample by the same laboratory on the vertical axis. Both axes are labeled with the sample number and test title. The horizontal and vertical scales used in plotting are selected to give the most informative display of the plotted points.

The vertical and horizontal dashed lines represent the average values for all the results on the first sample and the second sample, respectively. These lines divide the diagram into four quadrants, numbered from 1 through 4, beginning in the upper right quadrant and proceeding counterclockwise.

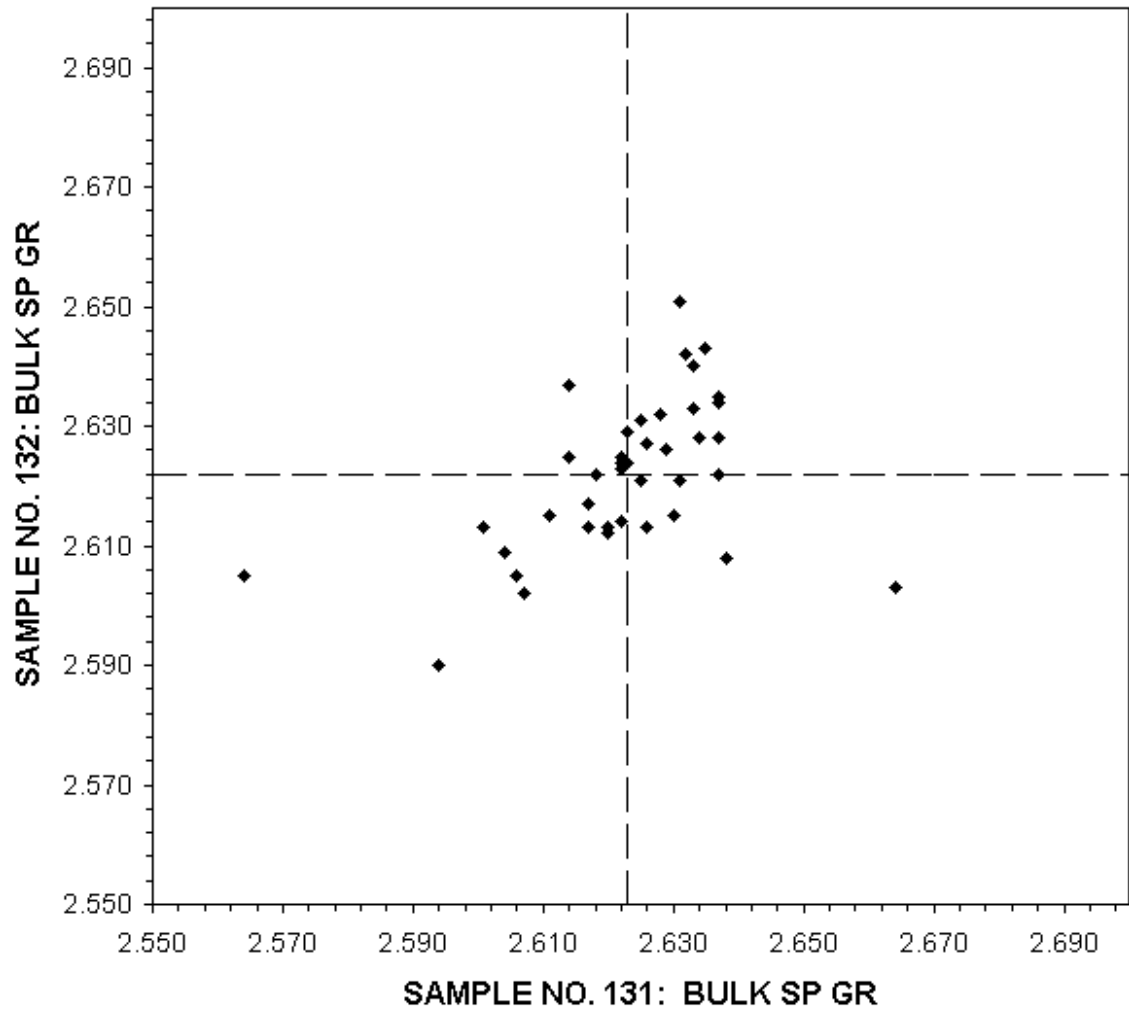
The first line of print under the diagram includes the test number in the order of appearance on the data sheet, the test title and the number of data points on the diagram. The number of plotted points may not agree with the total number of data pairs included in the analysis because some points may represent several data pairs which are identical.

The second and third lines give the averages, standard deviations and coefficients of variation for the first and second sample, respectively.

The entries which follow, if any, list the identification numbers of laboratory data eliminated from the statistical calculations based on the 3.0 standard deviation criterion discussed earlier.

# AMRL PROFICIENCY SAMPLE PROGRAM

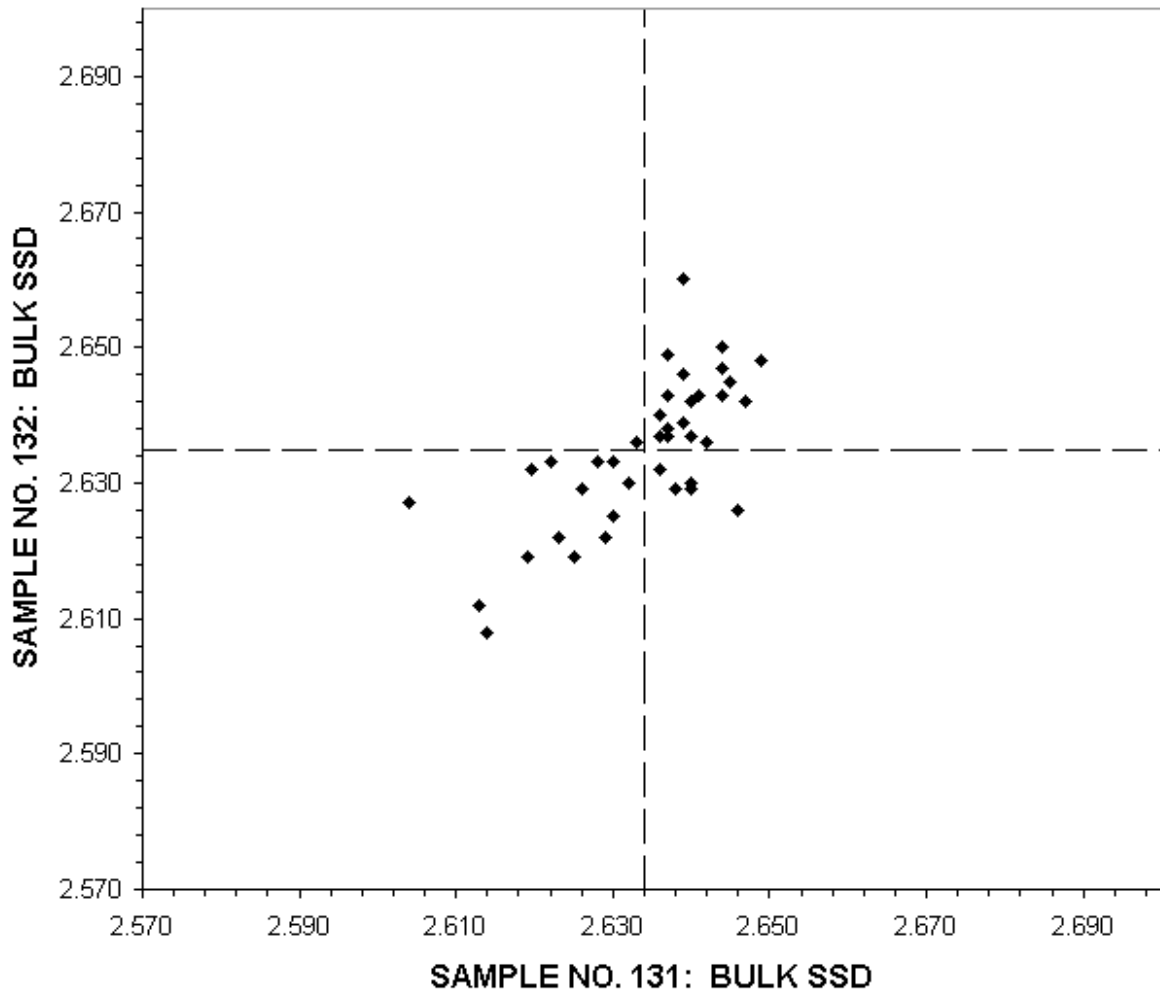
## TX TAPE METHOD SAMPLE NOS. 131 & 132



TEST NO. 1	BULK SPECIFIC GRAVITY	40 POINTS
SAMPLE NO. 131	AVE 2.6227 S.D. 0.016 C.V. 0.600	
SAMPLE NO. 132	AVE 2.6218 S.D. 0.013 C.V. 0.488	
LABS ELIMINATED	17 35	

# AMRL PROFICIENCY SAMPLE PROGRAM

## TX TAPE METHOD SAMPLE NOS. 131 & 132



TEST NO. 2      BULK SPECIFIC GRAVITY (SSD)      40 POINTS

SAMPLE NO. 131    AVE 2.6340    S.D. 0.010    C.V. 0.389

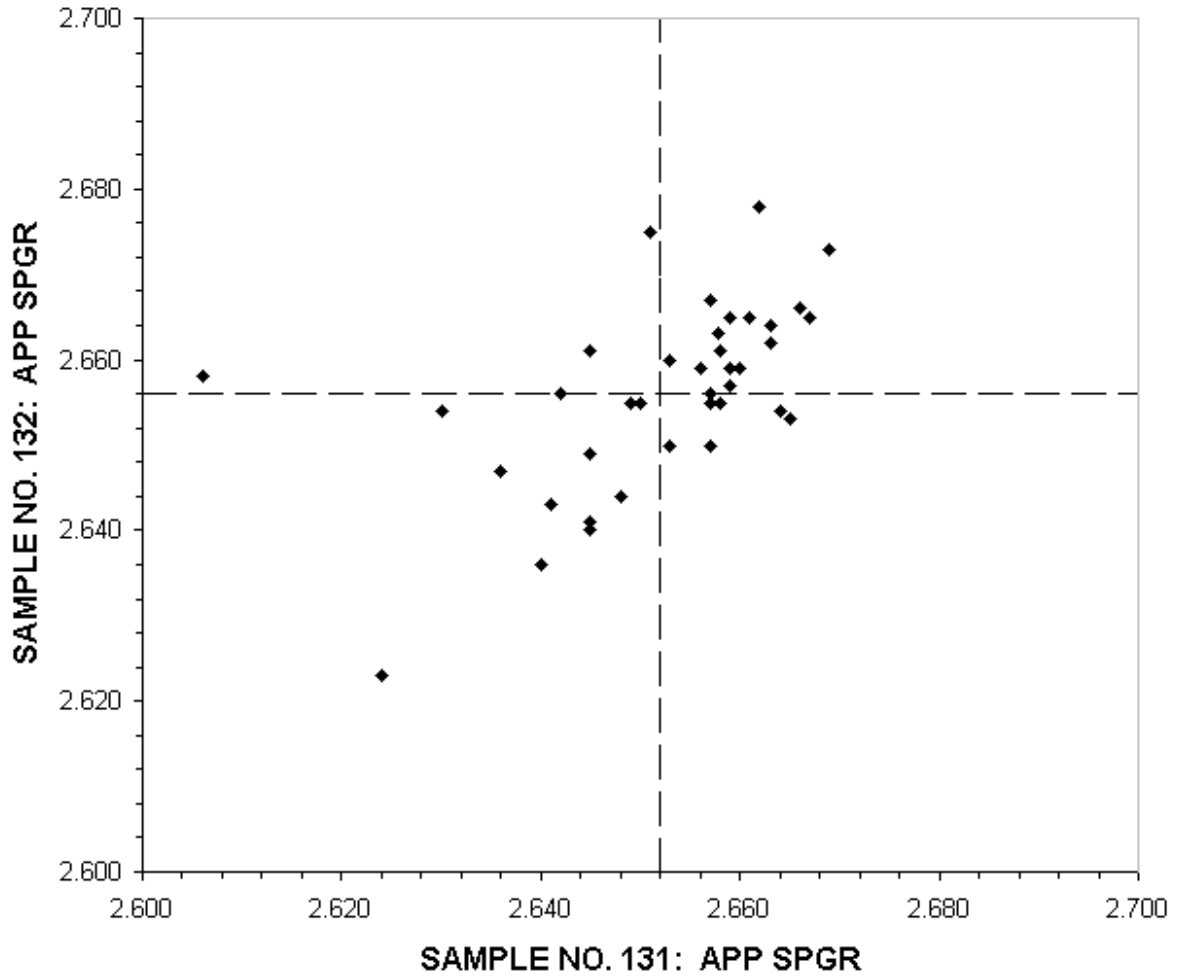
SAMPLE NO. 132    AVE 2.6348    S.D. 0.011    C.V. 0.409

LABS ELIMINATED    7    35



# AMRL PROFICIENCY SAMPLE PROGRAM

## TX TAPE METHOD SAMPLE NOS. 131 & 132



TEST NO. 3      APPARENT SPECIFIC GRAVITY      40 POINTS

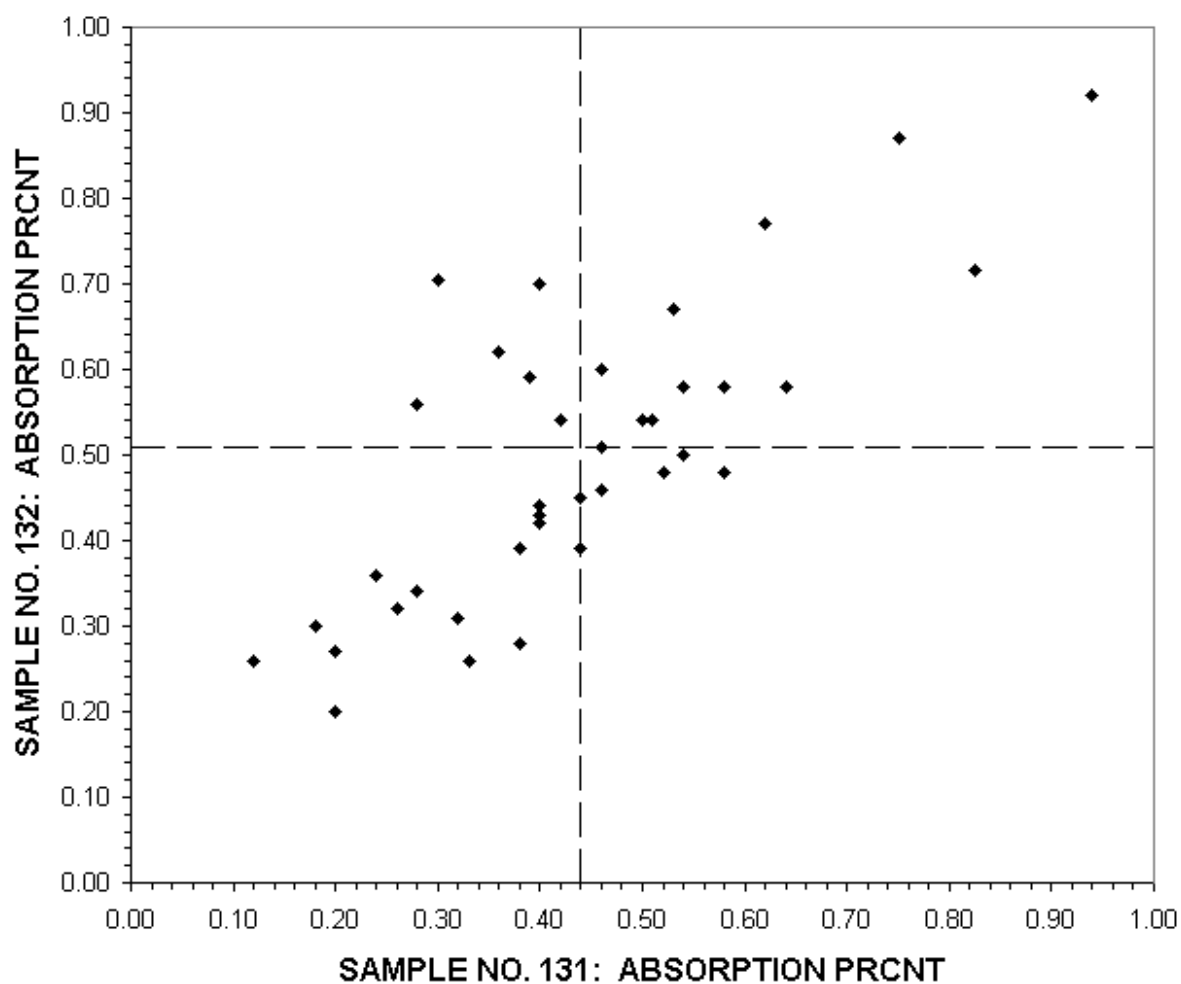
SAMPLE NO. 131    AVE 2.6524    S.D. 0.013    C.V. 0.475

SAMPLE NO. 132    AVE 2.6563    S.D. 0.011    C.V. 0.399

LABS ELIMINATED    3    14

# AMRL PROFICIENCY SAMPLE PROGRAM

## TX TAPE METHOD SAMPLE NOS. 131 & 132



TEST NO. 4	ABSORPTION PERCENT	40 POINTS
SAMPLE NO. 131	AVE 0.442 S.D. 0.17 C.V. 39.1	
SAMPLE NO. 132	AVE 0.506 S.D. 0.17 C.V. 34.4	
LABS ELIMINATED	3 35	

## Responses to Apparatus Used

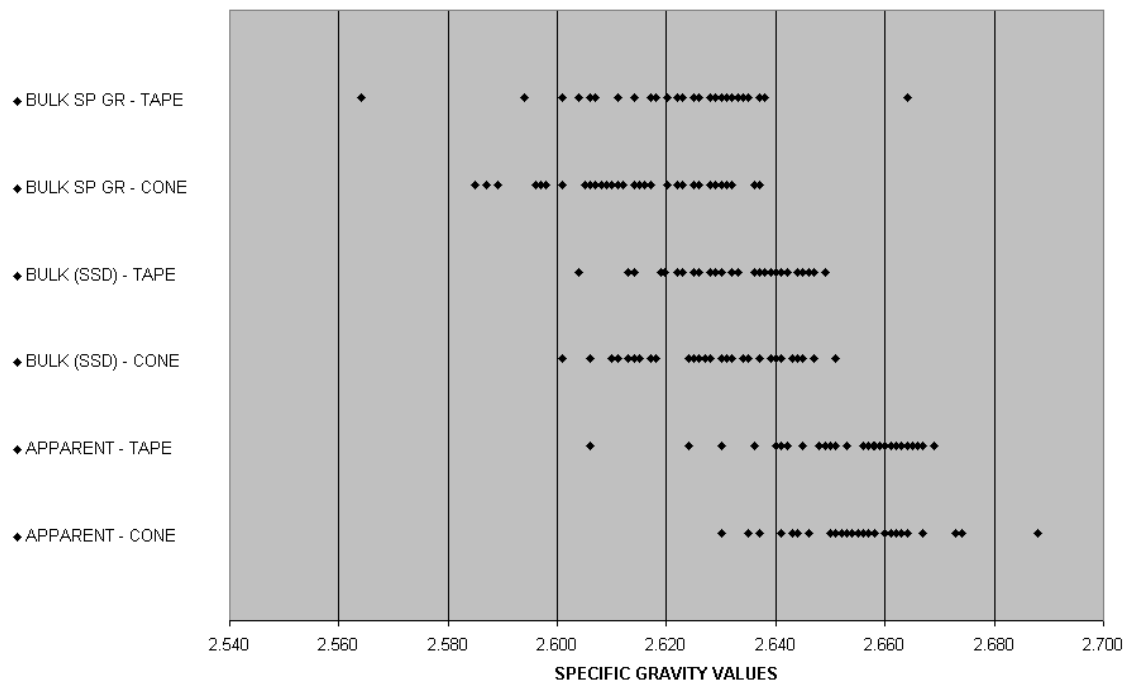
Of the 42 laboratories that participated in the study, 35 reported that they used the tape and woodblock provided with the samples. The remaining 7 laboratories did not respond to the question.

## Comments

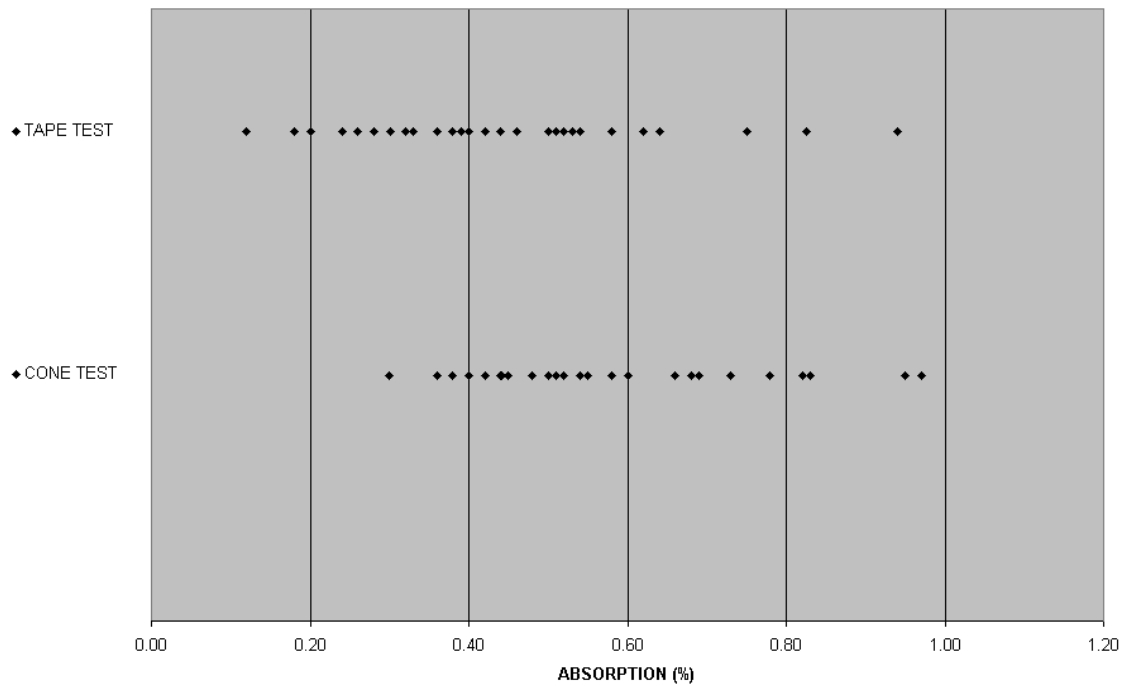
1. This method does give consistent results. My major concern is how do you tell when the sample has passed “surface dry” condition. With the cone test, you can tell when this has happened and you can then start over.
2. After being a part of this trial test for the second time we like it even less now than the first time. The instructions have become more confusing which opens up the possibility for different interpretations which will lead to more mistakes and or procedural steps done differently by each lab. We feel that there are other ways to decide when the material has reached SSD condition and find them easier to perform with satisfactory results. If there is a choice between the cone test method and the tape test method, the cone test wins hands down. Another issue is how exactly is the best way to attach the tape to the block?
3. It appears that both samples had to be air dried longer to reach SSD than by the “cone” method.
4. The surface dry condition occurs significantly later for the tape test then for the cone test, resulting in a drier sample at the saturated surface dry end point. The aggregate lab personnel prefer to use T84.
5. We could not get satisfactory results for the tape test. Test sample dried past SSD before tape test released sand from block and tape. Maybe we could get a video for this test?
6. This version of the test is awkward and cumbersome. Eliminate holding pan at 45 degree angle.
7. Instructions in Section 6.2.2 are unclear. Testing is inconsistent. One check would produce five adhering particles, and the next would produce ten adhering particles.
8. I find the second round of the “tape test” method much harder to perform than the first round.
9. We are happy to participate in this study and hope that we can do more in the future.
10. Cone method is still much simpler to perform and faster. Cone test is less subjective to error. Example of error: Pressure on tape when put on SSD aggregate.
11. Why use a rectangular pan? Why does the pan need to be tilted?

## Comparison of “Tape Test” vs. “Cone Test”

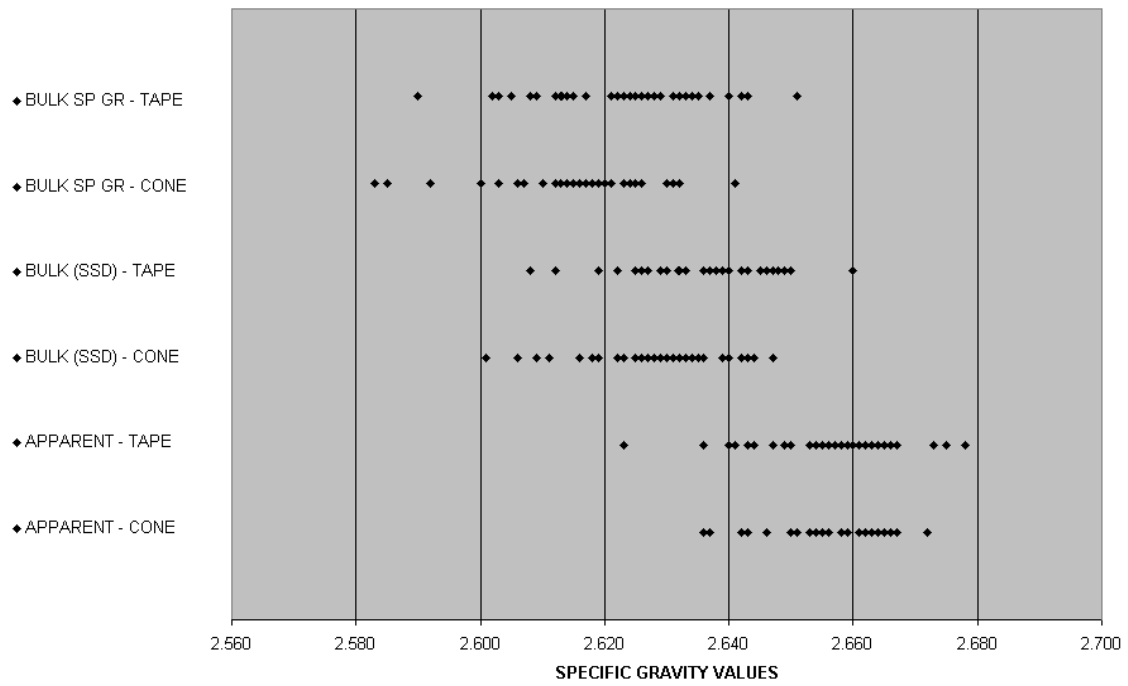
TAPE TEST VS CONE TEST FOR SPECIFIC GRAVITIES (SAMPLE 131)



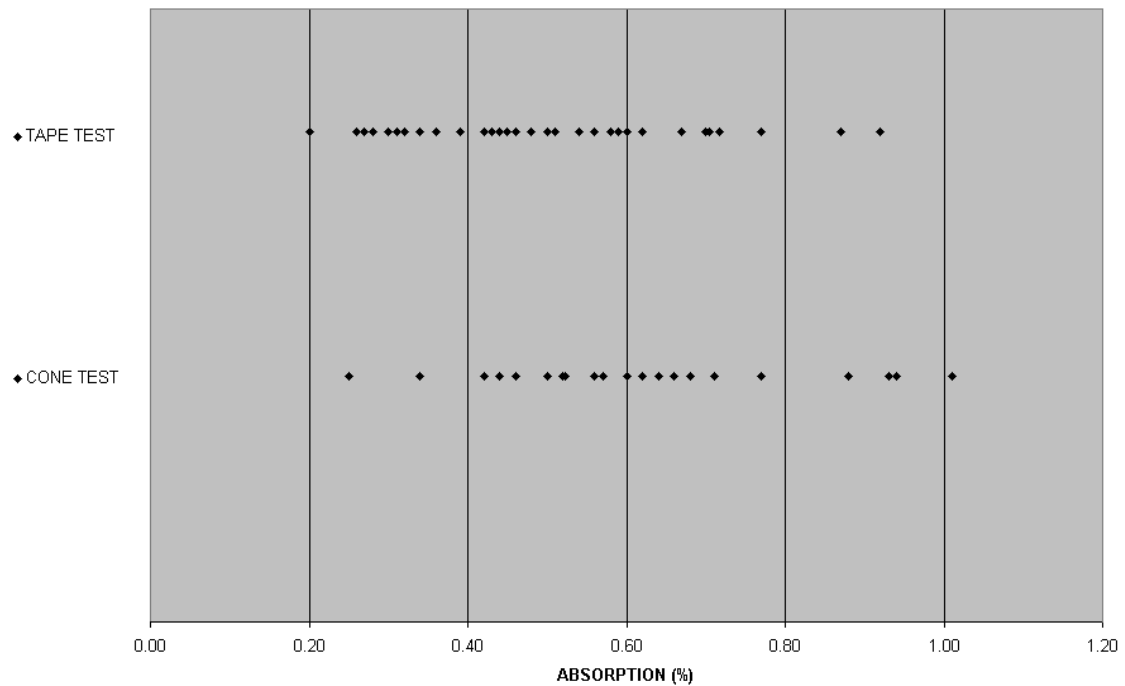
TAPE TEST VS CONE TEST FOR ABSORPTION TESTING (SAMPLE 131)



TAPE TEST VS CONE TEST FOR SPECIFIC GRAVITIES (SAMPLE 132)



TAPE TEST VS CONE TEST FOR ABSORPTION TESTING (SAMPLE 132)



**RESULTS PROVIDED BY PARTICIPATING LABORATORIES FOR "TAPE TEST" <sup>A</sup>**

Lab No.	Bulk Sp Gr		Bulk Sp Gr (SSD)		Apparent Sp Gr		Absorption	
	131	132	131	132	131	132	131	132
1	2.626	2.613	2.638	2.629	2.658	2.655	0.46	0.60
2	2.638	2.608	2.646	2.626	2.659	2.657	0.30	0.71
3	2.664	2.603	2.649	2.648	2.625	2.725	0.55	1.71
4	2.622	2.624	2.639	2.639	2.667	2.665	0.64	0.58
5	2.631	2.621	2.642	2.636	2.660	2.659	0.42	0.54
6	2.617	2.617	2.632	2.630	2.657	2.650	0.58	0.48
7	2.564	2.605	2.580	2.625	2.606	2.658	0.62	0.77
8	2.611	2.615	2.630	2.633	2.663	2.662	0.53	0.67
9	2.637	2.622	2.640	2.629	2.645	2.640	0.12	0.26
10	2.628	2.632	2.640	2.642	2.659	2.659	0.44	0.39
11	2.633	2.640	2.639	2.646	2.653	2.660	0.20	0.20
12	2.633	2.633	2.645	2.645	2.666	2.666	0.46	0.46
13	2.631	2.651	2.639	2.660	2.651	2.675	0.28	0.34
14	2.635	2.643	2.644	2.650	2.715	2.705	0.33	0.26
15	2.634	2.628	2.644	2.647	2.662	2.678	0.40	0.70
16	2.622	2.614	2.629	2.622	2.640	2.636	0.26	0.32
17	2.607	2.899	2.614	2.608	2.624	2.623	0.24	0.36
18	2.625	2.621	2.636	2.632	2.653	2.650	0.40	0.42
19	2.632	2.642	2.637	2.649	2.645	2.661	0.20	0.27
20	2.622	2.625	2.636	2.640	2.659	2.665	0.54	0.58
21	2.622	2.623	2.636	2.637	2.658	2.661	0.50	0.54
22	2.620	2.612	2.625	2.619	2.645	2.641	0.46	0.51
23	2.620	2.613	2.630	2.625	2.648	2.644	0.40	0.44
24	2.637	2.628	2.644	2.643	2.657	2.667	0.28	0.56
25	2.614	2.637	2.604	2.627	2.630	2.654	0.38	0.39
26	2.601	2.613	2.620	2.632	2.658	2.663	0.83	0.72
27	2.625	2.631	2.641	2.643	2.663	2.664	0.51	0.54
28	2.618	2.622	2.633	2.636	2.658	2.661	0.58	0.58
29	2.626	2.627	2.637	2.638	2.656	2.659	0.44	0.45
30	2.606	2.605	2.619	2.619	2.641	2.643	0.50	0.54
31	2.637	2.635	2.641	2.643	2.649	2.655	0.18	0.30
32	2.623	2.629	2.637	2.643	2.661	2.665	0.54	0.50
33	2.630	2.615	2.640	2.630	2.657	2.656	0.39	0.59
34	2.617	2.613	2.626	2.629	2.642	2.656	0.36	0.62
35	2.535	2.526	2.584	2.574	2.665	2.653	1.92	1.90
36	2.594	2.590	2.613	2.612	2.645	2.649	0.75	0.87
37	2.637	2.634	2.647	2.642	2.664	2.654	0.38	0.28
38	2.623	2.624	2.637	2.637	2.659	2.657	0.52	0.48
39	2.614	2.625	2.622	2.633	2.636	2.647	0.32	0.31
40	2.607	2.602	2.623	2.622	2.650	2.655	0.62	0.77
41	2.604	2.609	2.628	2.633	2.669	2.673	0.94	0.92
42	2.629	2.626	2.640	2.637	2.657	2.655	0.40	0.43

<sup>A</sup> Shaded cells were beyond 3.0 standard deviations and were not included in the analysis.

**"CONE TEST" RESULTS PROVIDED BY PARTICIPATING LABORATORIES <sup>A</sup>**

Lab No.	Bulk Sp Gr		Bulk Sp Gr (SSD)		Apparent Sp Gr		Absorption	
	131	132	131	132	131	132	131	132
1	2.625	2.623	2.635	2.635	2.652	2.655	0.38	0.46
2	2.626	2.625	2.637	2.639	2.656	2.661	0.44	0.52
3	2.607	2.607	2.632	2.631	2.673	2.672	0.95	0.93
4	2.598	2.626	2.618	2.640	2.652	2.665	0.78	0.56
5	2.616	2.618	2.631	2.635	2.658	2.663	0.60	0.64
6	2.617	2.619	2.632	2.634	2.657	2.659	0.58	0.56
7	2.601	2.603	2.617	2.616	2.643	2.637	0.60	0.50
8	2.611	2.614	2.630	2.632	2.662	2.661	0.73	0.68
9	2.597	2.614	2.615	2.626	2.644	2.646	0.69	0.46
10	2.637	2.632	2.647	2.643	2.662	2.661	0.36	0.42
11	2.631	2.618	2.639	2.632	2.660	2.667	0.30	0.50
12	2.630	2.632	2.643	2.644	2.664	2.664	0.48	0.46
13	2.637	2.606	2.651	2.623	2.674	2.651	0.52	0.66
14	2.629	2.621	2.640	2.630	2.721	2.719	0.40	0.34
15	2.632	2.625	2.647	2.640	2.673	2.665	0.58	0.56
16	2.614	2.606	2.628	2.622	2.651	2.650	0.54	0.64
17	2.606	2.607	2.615	2.618	2.630	2.636	0.36	0.42
18	2.620	2.618	2.632	2.630	2.651	2.650	0.44	0.46
19	2.620	2.631	2.632	2.642	2.652	2.662	0.45	0.44
20	2.598	2.620	2.632	2.636	2.688	2.662	1.30	0.60
21	2.628	2.615	2.641	2.633	2.663	2.663	0.50	0.68
22	2.606	2.616	2.613	2.625	2.635	2.651	0.51	0.60
23	2.623	2.606	2.634	2.619	2.654	2.642	0.44	0.52
24	2.610	2.612	2.627	2.628	2.656	2.655	0.66	0.62
25	2.616	2.616	2.601	2.601	2.641	2.642	0.58	0.60
26	2.605	2.613	2.626	2.633	2.662	2.666	0.82	0.77
27	2.614	2.613	2.632	2.630	2.658	2.658	0.66	0.64
28	2.623	2.614	2.634	2.627	2.653	2.650	0.42	0.52
29	2.612	2.612	2.630	2.630	2.660	2.661	0.68	0.71
30	2.587	2.592	2.606	2.609	2.637	2.637	0.73	0.66
31	2.615	2.617	2.630	2.633	2.655	2.659	0.58	0.60
32	2.622	2.630	2.637	2.644	2.662	2.667	0.55	0.52
33	2.585	2.585	2.610	2.611	2.651	2.654	0.97	1.01
34	2.611	2.614	2.626	2.629	2.651	2.653	0.58	0.56
35	2.589	2.583	2.611	2.606	2.646	2.643	0.83	0.88
36	2.596	2.600	2.614	2.616	2.643	2.643	0.68	0.62
37	2.632	2.624	2.644	2.639	2.663	2.663	0.44	0.56
38	2.611	2.615	2.627	2.630	2.653	2.656	0.60	0.60
39	2.609	2.621	2.624	2.636	2.650	2.661	0.60	0.57
40	2.608	2.610	2.625	2.628	2.654	2.658	0.66	0.68
41	2.610	2.600	2.631	2.625	2.667	2.665	0.82	0.94
42	2.636	2.641	2.645	2.647	2.661	2.658	0.36	0.25

<sup>A</sup> Shaded cells were beyond 3.0 standard deviations and were not included in the analysis.